



Impact of space-borne estimates of hydrological variables in early warning systems: analysis of recent severe weather events over Europe

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Many severe precipitation events occurred in Europe during the last decade and caused casualties and damages to the historical heritage and natural environment. Protection of civilians and safeguard of the territory are the key mandates of a civil Protection (CP) agency. This is achieved through activities that mitigate hydro-meteorological risks, such as flooding and droughts. European CP agencies, supported by meteorological and hydrological institutes, aim to assess risk scenarios, to monitor and supervise events and risk levels, providing early warning to National and local authorities.

Hydro meteorological risk management consists of three phases: pre-event (forecast), event (early warning, and monitoring) and post-event (recovery and survey).

Near real time accurate estimations of hydrological variables such as precipitation and soil moisture are invaluable to the CP agencies, enable them to issue early warnings and plan for disaster relief at the local level.

Besides measurements of key hydrological variables by ground-based instruments, often affected by a limited spatial coverage, advanced satellite-based precipitation and soil moisture products developed within different international programs, are becoming available and accessible to users in near-real time. The assessment of the accuracy and reliability of such products is necessary in order to be able to optimally exploit them for hydro-meteorological applications.

The comparison of satellite-derived rainfall and soil moisture estimates with respect to ground-based measurements is a challenging task, both because of the temporal and spatial variability of the fields and the inherently different measurement types. This activity is particularly complex in Europe due to the heterogeneity in the ground-based networks of the different countries, due to sampling strategy and processing methodologies.

For the validation and assessment of satellite-derived soil moisture products, these issues are exacerbated by the limited availability of ground observation networks that can be used as benchmark. Moreover, the measuring stations cover only small areas over Europe. As an example, in Central Italy only 14 probes are distributed over an area of about 8000 km².

In this study, a comparison between satellite derived products and ground data is presented, according to the EUMETSAT H SAF (Satellite Application Facility on Support to Operational Hydrology and Water Management) Validation protocols. Since 2005, eleven European countries joined in the framework of the H SAF to perform the satellite products monitoring and ground verification in their own regions of interest.

Moreover, recent severe rainfall events are selected in order to understand how the main satellite product characteristics, i.e. accuracy, spatial pattern and resolution, update frequency and latency, impact the efficiency of a hydro-meteorological early warning system at a local level in an operational framework. State-of-the-art satellite rainfall and soil moisture products, obtained through international space agencies and programmes (EUMETSAT, H SAF, ESA, NASA, and JAXA), are used over different European countries as forcing input for an early warning system for meteorological/hydrological events.